

## CLAIMS

1. An internal combustion engine comprising at least one cylinder and at least one laser light source for time-controlled externally supplied ignition, characterised in that there is provided at least one holographic optical element for focussing of the laser light.
2. An internal combustion engine according to claim 1 characterised in that the laser light is focussed in the combustion chamber on to at least two real focal points.
3. An internal combustion engine according to claim 2 characterised in that the light focussed on to at least two focal points issues from just one laser light source.
4. An internal combustion engine according to claim 1 characterised in that there is provided just one laser light source per cylinder.
5. An internal combustion engine according to claim 1 characterised in that there is provided just one laser light source for the entire internal combustion engine.
6. An internal combustion engine according to claim 2 characterised in that the intensity of the laser light is or can be individually predetermined at each focal point.
7. An internal combustion engine according to claim 1 characterised in that exclusively the phase of the laser light wave front is influenced by the holographic optical element.
8. An internal combustion engine according to claim 1 characterised in that the holographic optical element is lithographically produced.
9. An internal combustion engine according to claim 1 characterised in that the holographic optical element includes a plate, with a defined local variation in thickness.

10. An internal combustion engine according to claim 9 characterised in that the plate is made of one of the group consisting of glass and sapphire.

11. An internal combustion engine according to claim 1 characterised in that the holographic optical element includes a plate with a defined local variation in refractive index.

12. An internal combustion engine according to claim 11 characterised in that the plate is made of one of the group consisting of glass and sapphire.

13. An internal combustion engine according to claim 1 characterised in that it has at least one optical transmission means.

14. An internal combustion engine according to claim 1 characterised in that it has at least one coupling-in optical system for coupling the laser light into at least one combustion chamber.

15. An internal combustion engine according to claim 13 characterised in that the optical transmission means include at least one holographic optical element.

16. An internal combustion engine according to claim 14, characterised in that the coupling-in optical system includes at least one holographic optical element.

17. An internal combustion engine according to claim 1 characterised in that at least one collimating optical means is arranged in the beam path of the laser light upstream of the holographic optical element.

18. An internal combustion engine according to claim 1 characterised in that at least one focussing optical element, is arranged in the beam path of the laser light upstream of the holographic optical element.

19. An internal combustion engine according to claim 1 characterised in that at least one focussing optical element, is arranged in the beam path of the laser light downstream of the holographic optical element.

20. An internal combustion engine according to claim 1, characterised in that at least one focussing optical element is a lens.

21. An internal combustion engine according to claim 1 characterised in that the focal length ( $f$ ) of at least two focal points is different.

22. An internal combustion engine according to claim 1 characterised in that it is one of the group consisting of a carburettor Otto cycle engine, an injection Otto cycle engine and a gas Otto cycle engine operated with fuel which is gaseous in the normal condition.

23. An internal combustion engine according to claim 1, characterised in that it is a multi-cylinder engine.

24. An internal combustion engine according to claim 1 characterised in that it is a stationary engine.

25. An internal combustion engine according to claim 1 characterised in that the fuel-air mixture in the combustion chamber is homogeneous.

26. An internal combustion engine according to claim 1 characterised in that there is provided an electronic engine management system which, in dependence on detected engine parameters actuates the laser light source or sources and in so doing establishes laser light parameters.

27. An internal combustion engine according to claim 26, characterised in that the detected engine parameters are at least one of the group consisting of the crankshaft

angle ( $\alpha$ ), the rotary speed ( $n$ ), the engine output ( $N$ ) and the current cylinder pressure ( $P_i$ ) in the combustion chamber .

28. An internal combustion engine according to claim 26 characterised in that the laser light parameters are at least one of the group consisting of the succession in respect of time, the pulse duration and/or the firing energy.

29. An internal combustion engine according to claim 1 characterised in that the fuel-air mixture is fired per working cycle of a cylinder by at least two laser light pulses which occur in succession in respect of time.

30. An internal combustion engine according to claim 1 characterised in that the air fuel ratio ( $\lambda$ ) of the fuel-air mixture in the combustion chamber is greater than 1.9.